

Project:  
Synthetic Aperture Sonar Survey to Locate Archaeological Resources in the Stellwagen Bank  
National Marine Sanctuary

Project Dates: 23 August – 1 September 2010

Principal Investigator:  
Matthew Lawrence, Maritime Archaeologist, Stellwagen Bank National Marine Sanctuary

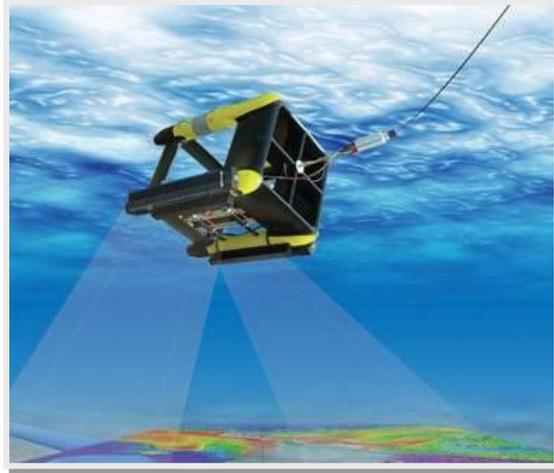


Figure 1: PROSAS Surveyor towfish (Courtesy AST).

## Table of Contents

<u>Cruise Overview</u>	
Chief Scientist	1
Vessel	1
Study Area	2
Project Goals	2
Project Objectives	2
<u>Description of Operations</u>	2
<u>Itinerary</u>	3
<u>Personnel</u>	4
<u>Organizational Structure</u>	4
<u>Equipment</u>	4
<u>Disposition of Data</u>	5
<u>Emergency information</u>	6
<u>Communications</u>	6
Appendix A. Primary Operating Area Maps	7

## Cruise Overview

### Chief Scientist:

Matthew Lawrence, Principal Investigator and Maritime Archaeologist, Stellwagen Bank National Marine Sanctuary, 175 Edward Foster Road, Scituate, MA 02066  
781-545-8026 x214, [Matthew.Lawrence@noaa.gov](mailto:Matthew.Lawrence@noaa.gov)

### Vessel:

*SRVx* is operated by the Office of National Marine Sanctuaries. *SRVx* measures 85 feet long by 23 feet wide. Powered by twin 2,735 HP engines, the vessel has a top speed of 35 kts. At cruise speed it has a 1,700 mile range. During the project, vessel speed will be limited to 16 kts to reduce the likelihood of a marine mammal strike. The vessel has berthing for 4 crew and 8 scientists.



Figure 2. Portside view of the *SRVx* underway.



Figure 3. View of the *SRVx*'s aft deck.

### Study Area:

Northwest corner of Stellwagen Bank National Marine Sanctuary, encompassing 200 square kilometers of seafloor. See Figures 6 and 7 in Appendix A.

### Project goals:

1. Locate sonar targets with archaeological resource characteristics in the Stellwagen Bank National Marine Sanctuary (SBNMS).
2. Demonstrate the efficiency and effectiveness of synthetic aperture sonar technology for locating archaeological resources.
3. Locate derelict fishing gear and quantify its distribution and prevalence.
4. Inform research zoning discussions of the SBNMS Ecosystem Based Management Working Group.
5. Present project methodology and results to the archaeological community and the general public.

### Project Objectives:

1. Map 200 square-kilometers (km) of seafloor on the approaches to Gloucester, Salem, Marblehead, and Boston using the PROSAS Surveyor.
2. Identify sonar targets with archaeological resource characteristics and create a geo-database with the target positions and characteristics for analysis with the SBNMS Maritime Heritage GIS.
3. Develop geo-rectified seafloor maps for analysis with the SBNMS Maritime Heritage GIS.
4. Develop a geo-database of derelict fishing gear locations and characteristics.
5. Utilize geo-rectified seafloor maps to develop seafloor habitat characterization of the survey area.
6. Present project methodology and results at the 2012 Society for Historical Archaeology Conference.
7. Publish project methodology and results in the *Journal of Maritime Archaeology*.
8. Develop a project webpage on the SBNMS website to inform the general public about the project.

### Description of Operations

This project utilizes marine remote sensing survey methods to locate sonar targets with archaeological resource characteristics. The sole data collection device is an Applied Signal Technology, Inc. (AST) PROSAS Surveyor synthetic aperture sonar system. The synthetic aperture sonar transducers and electronics are mounted on a MacArtney FOCUS-2 remotely operated towed vehicle. Utilizing a spaced lane survey methodology to achieve 100% seafloor coverage, the project will investigate the survey area and develop high-resolution seafloor maps that will be used to meet the project's goals. Survey lanes will be oriented to follow seafloor bathymetric features so as to minimize depth changes along the survey lane. Survey lane spacing will be staggered at 130 m and 280 m intervals so as to ensonify the nadir below the towfish and achieve 100 % coverage of the survey area. See Figure 8 in Appendix A for the survey lane plan. The PROSAS Surveyor will collect data across a 300 m swath with a 30 m wide nadir. The towfish will be controlled by its dynamic fins and winch to fly at a 15 m altitude above the seafloor. Tow speeds will be between 3 and 4 kts to achieve to swath resolution.

The PROSAS Surveyor towfish will be deployed and recovered from the *SRVx*'s stern A-frame. When onboard, the towfish will sit within the well deck area at the vessel's stern. The PROSAS

Surveyor's tow winch will be mounted on the stern deck, aft of the pilot house. Electrical power for the tow winch will be provided by the *SRVx*'s generators. The PROSAS Surveyor system utilizes a USBL tracking system for positioning. The vessel's USBL transponder will be affixed to a portside amidships transponder pole specifically designed for that purpose.

PROSAS Surveyor control and sonar display equipment will be setup within the drylab space of the *SRVx*. This space will be the heart of survey operations as the navigation computer will also run from this location. Navigation information will be displayed to the vessel operator using HYPACK MAX software displayed by a remote monitor next to the helm.

Survey operations will take place on a 24 hour a day basis, with sonar pilots rotating to maintain fresh eyes. Vessel crew will similarly rotate to maintain sufficient staffing levels to operate within regulations and stay vigilant. The project will mobilize and demobilize from Fairhaven, MA. Once the *SRVx* departs from Fairhaven to begin the survey, the vessel will not return until the survey's completion. Instead, the project will utilize Gloucester, MA as a rendezvous point for day observers and to resupply the vessel.

The Principal Investigator will review sonar data as its acquired and will develop a geo-database that includes the position and characteristics of all sonar targets that have characteristics of archaeological resources and derelict fishing gear. When the Principal Investigator is off-duty, the PROSAS Surveyor pilots will continue to log sonar targets. The Principal Investigator will review all data gathered for sonar targets, following the survey's completion, to ensure that all sonar targets were identified and logged in the geo-database.

During data acquisition, specifically-sized section of the PROSAS seafloor map will be processed into geo-rectified TIFF files for import into the SBNMS Maritime Heritage GIS. The TIFF files will be full-resolution images that when mosaiced will create a full-resolution seafloor map. The geographic extents of each file will be sized to create TIFF files easily managed by the sanctuary's GIS computers. To facilitate the display of these files, the Principal Investigator will create polygon SHAPE files delimiting the extents of each TIFF file. The SHAPE files will serve as an easily displayed index to the TIFF files.

### Itinerary

23 August 2010 – Mobilize PROSAS Surveyor on the *SRVx* at the Fairhaven Shipyard North, Fairhaven, MA

24 August 2010 – Mobilize PROSAS Surveyor on the *SRVx* at the Fairhaven Shipyard North, Fairhaven, MA. When equipment is fully setup, the team will take a several hour shake-down cruise south of New Bedford, MA to familiarize personnel with the system and insure its operation while in SBNMS.

25 August – Depart Fairhaven, MA and transit to southern end of the survey area in SBNMS. Estimated time of arrival is 4.75 hours from departure. Upon reaching the survey area, science and vessel crew will begin survey procedures within an area that has little seafloor relief and no fixed fishing gear. Commence 24-hour survey operations.

26 August – Continue 24-hour survey operations. Pause survey operations at appropriate time to make an 0800 to pick-up of day visitors at Gloucester, MA. Resume survey operations. Continue

survey operations until late afternoon and then drop off day visitors in Gloucester, MA at 1700. Continue survey operations.

27 August – Continue 24-hour survey operations.

28 August – Continue 24-hour survey operations

29 August – Continue 24-hour survey operations

30 August – Continue 24-hour survey operations. Pause survey operations at appropriate time to make an 0800 to pick-up of day visitors at Gloucester, MA. Resume survey operations. Continue survey operations until late afternoon and then drop off day visitors in Gloucester, MA at 1700. Continue survey operations.

31 August – Continue 24-hour survey operations.

1 September – Continue 24-hour survey operations until 0300 and then transit back to Fairhaven, MA. Demobilize equipment from the *SRVx* and ready equipment for shipment back to AST's facility.

### Personnel

#### Vessel Crew:

Robert Wallace, Captain  
Dave Arch, Mate  
Chris Fosdick, Mate  
Steve Kibner, Mate

#### Science Crew:

Matthew Lawrence, Principal Investigator  
Andy Wilby, Chief Engineer  
Steven Ruddy, AST Business Manager  
PROSAS Pilot  
PROSAS Pilot  
PROSAS Pilot

### Organizational Structure

-AST personnel have responsibility for the safe and effective operation of the PROSAS Surveyor. Andy Wilby leads the AST team.

-The Principal Investigator has responsibility for determining the area to be surveyed as long as it does not jeopardize the safe operation of the PROSAS Surveyor. The Principal Investigator will establish and populate a geo-database to quantify and characterize sonar targets located during the survey. The Principal Investigator will develop archaeological research reports, websites, and publications to disseminate the methodology and results of the project.

-The *SRVx*'s crew has responsibility for the safe and effective operation of the research vessel.

### Equipment

#### Vessel Provided:

- 1) A-frame
- 2) 440 VAC 3-phase power for the PROSAS Surveyor winch
- 3) USBL Transponder pole

4) Berthing and food for 10 scientists and crew

SBNMS Provided:

- 1) Hypack software and laptop for survey navigation
- 2) Hard Drive recording media for data

AST Provided:

- 1) Complete PROSAS Surveyor system: including winch, towfish, block, acquisition computers and associated electronics

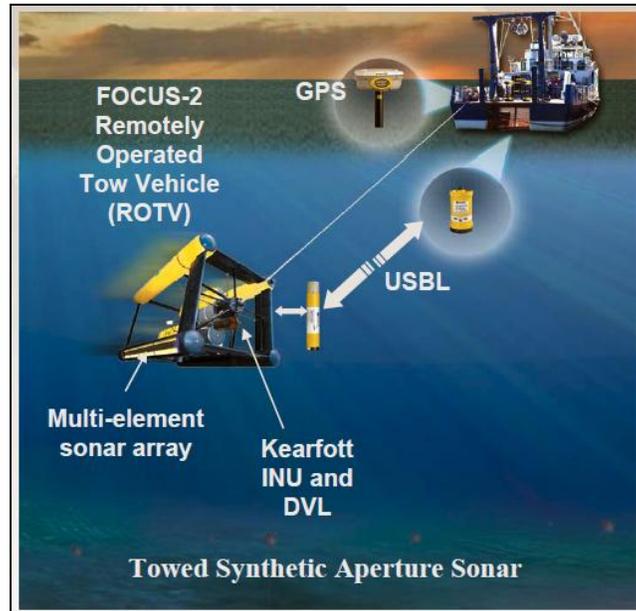


Figure 4. Components of the PROSAS Surveyor system (Courtesy AST).



Figure 5. PROSAS Surveyor control module and tow winch.

### Disposition of Data

Data: All PROSAS Surveyor data will be recorded to 1 TB SATA hard drives. Anticipated data output is expected to be 14 TB. Processed seafloor Geo-Tiff mosaics will be recorded to the same media. SBNMS will maintain the archive of raw and processed data at its facility in Scituate, MA.

Records: SBNMS will maintain a project archive of all written and electronic records relating to this project at its facility in Scituate, MA. The principal investigator is responsible for producing archaeological fieldwork reports and materials required by OER funding.

Real Time Products: The principal investigator will document the project with high-definition video and digital still photos. This material will be synthesized into products suitable for public interpretation on the SBNMS and OER websites. All video and still photos relating to the project will be archived at the SBNMS facility in Scituate, MA.

#### Emergency information

The Principal Investigator will maintain a file of emergency contact information for personnel participating in this cruise. As this information is Personally Identifiable Information (PII) and subject to strict control, it is not included within the cruise plan.

#### Communications

During survey operations, the research vessel will be within cellular phone range of Gloucester, MA. The Principal Investigator will be reachable at 617-827-4368. Similarly, email communication will be possible through a cellular data card connected to the Principal Investigators' laptop computer.

Appendix A. Primary Operating Area Maps

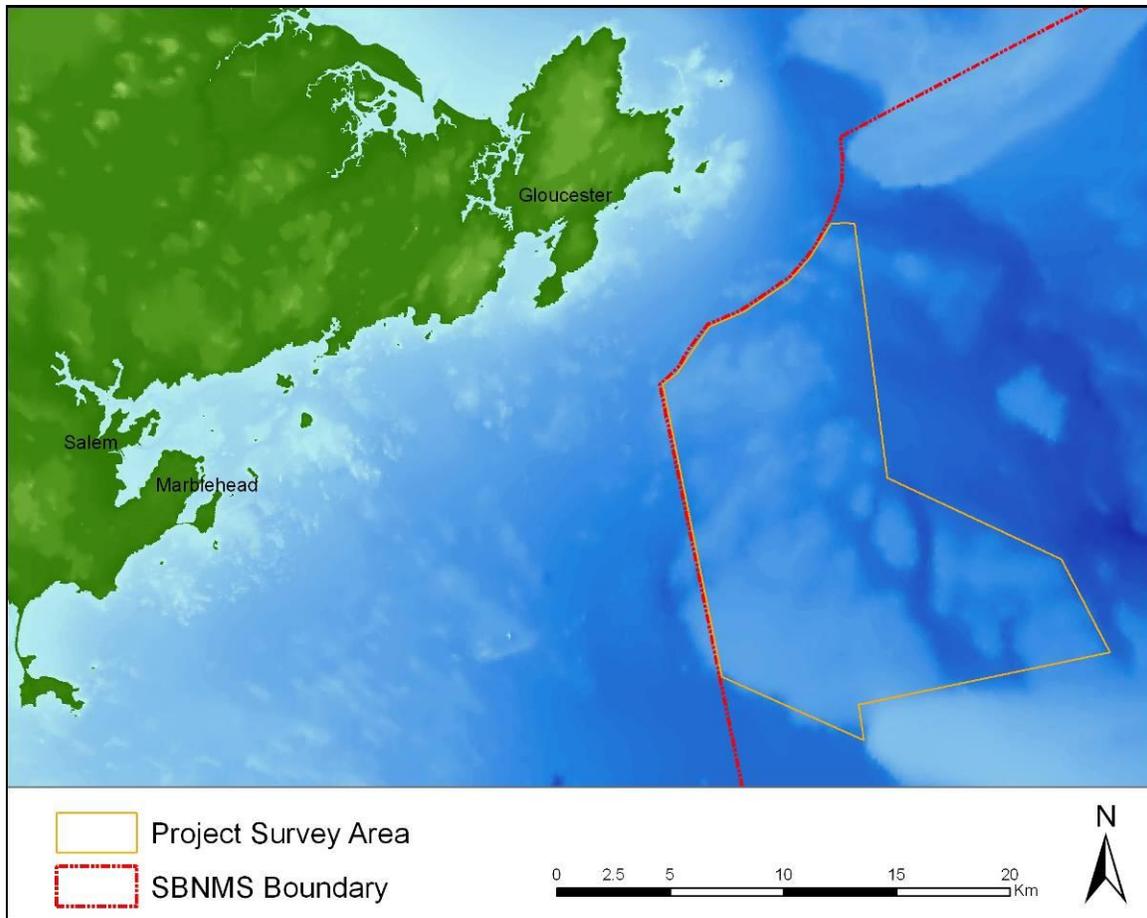


Figure 6. The planned survey area in relation to Massachusetts' historic ports.

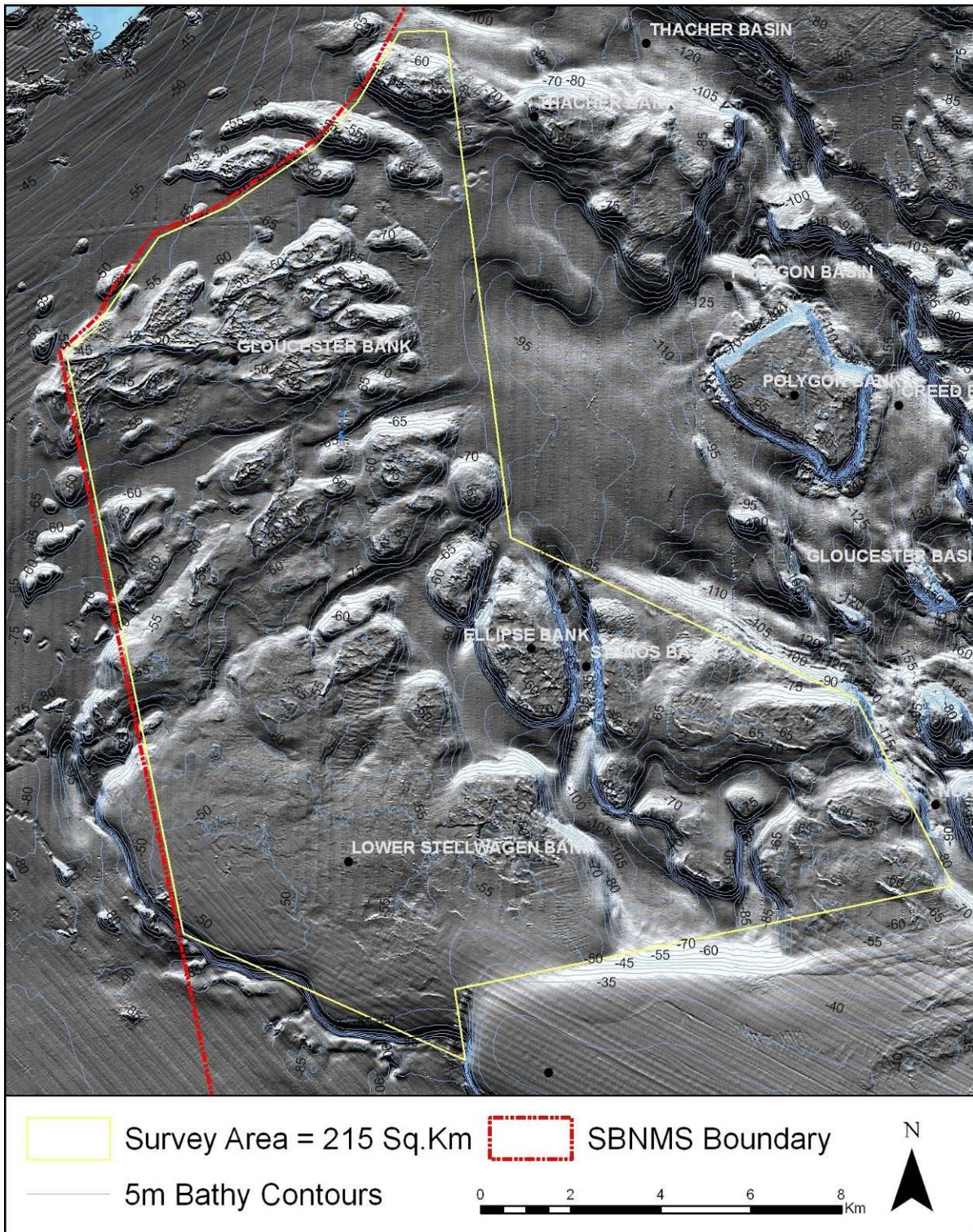


Figure 7. Detailed map of the survey area's seafloor topography.

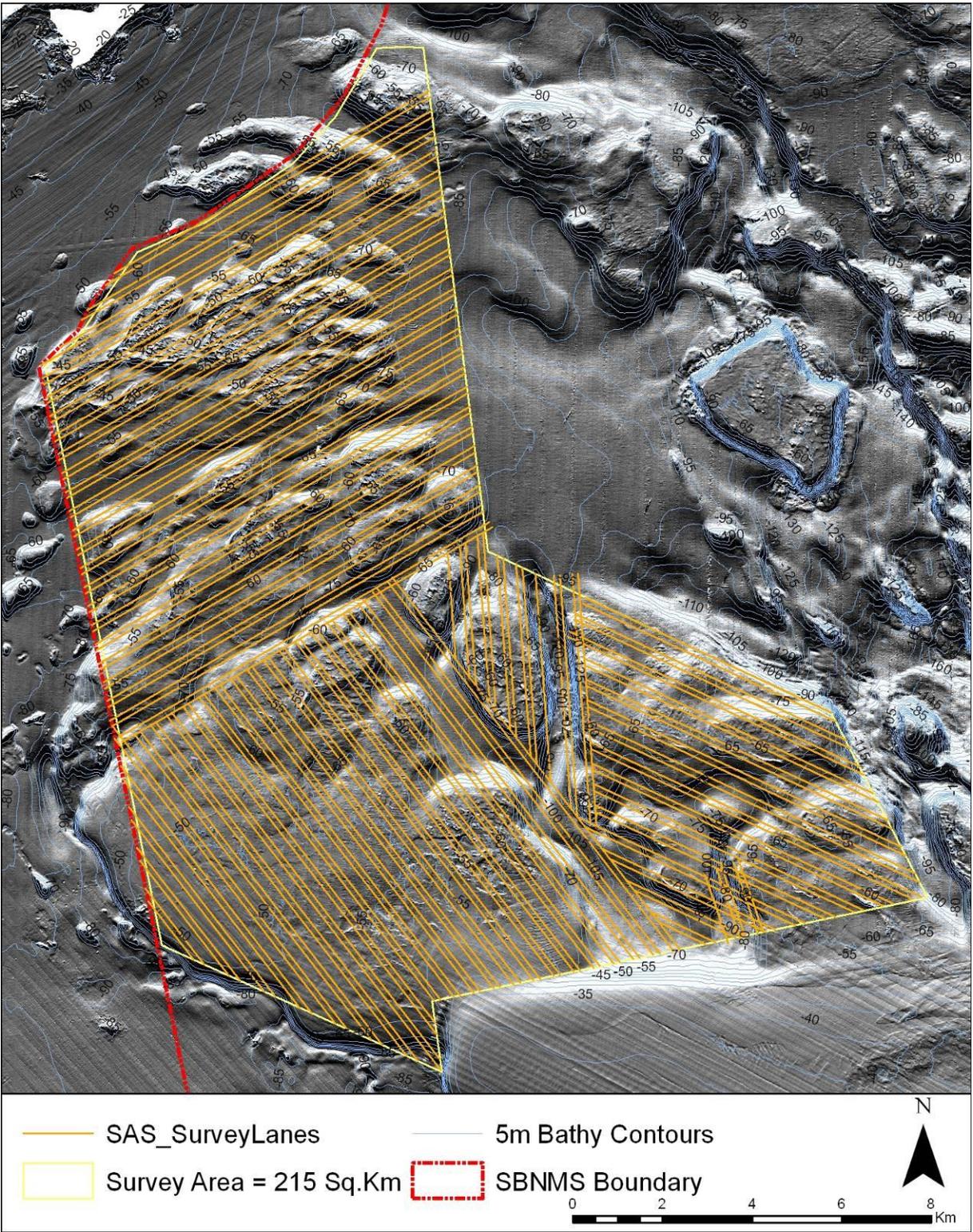


Figure 8. The project’s planned survey lanes.